System power supply for CD radio cassette players

BA3938

The BA3938 is a system power supply IC for use in CD radio cassette players. With one 11V output and interlocked outputs of 8.5V, 9V, and Vcc, the IC is best suited for CD radio cassette players.

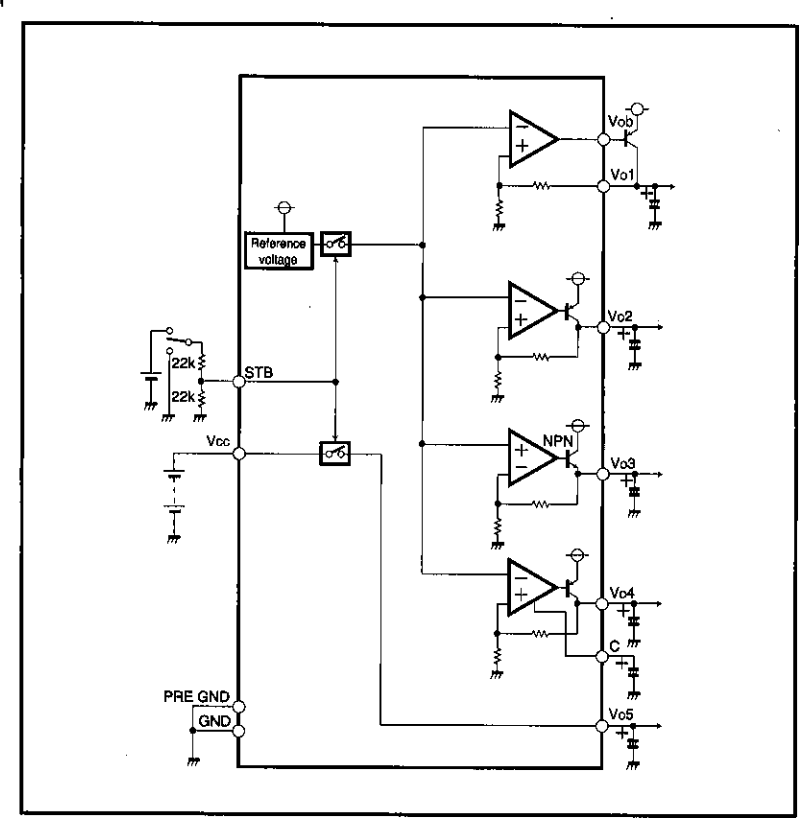
●Applications

CD radio cassette players

●Features

1) One 11V output (external transistor required) and interlocked outputs of 8.5V, 9V, and Vcc are built in.
2) Output current limit circuit protects the IC against short-circuiting damage.
3) Compact HSIP-B12 package allows a large power dissipation.

●Block diagram



●Absolute maximum ratings (Ta=25℃)

Parameter	Symbol	Limits	Unit
Power supply voltage	Vcc	24	V
Power dissipation	Pd	2200	mW
Operating temperature	Topr	−25~75	℃
Storage temperature	Tstg	−55 ~150	℃

* Reduce power by 17.6mW for each degree abobe 25℃.

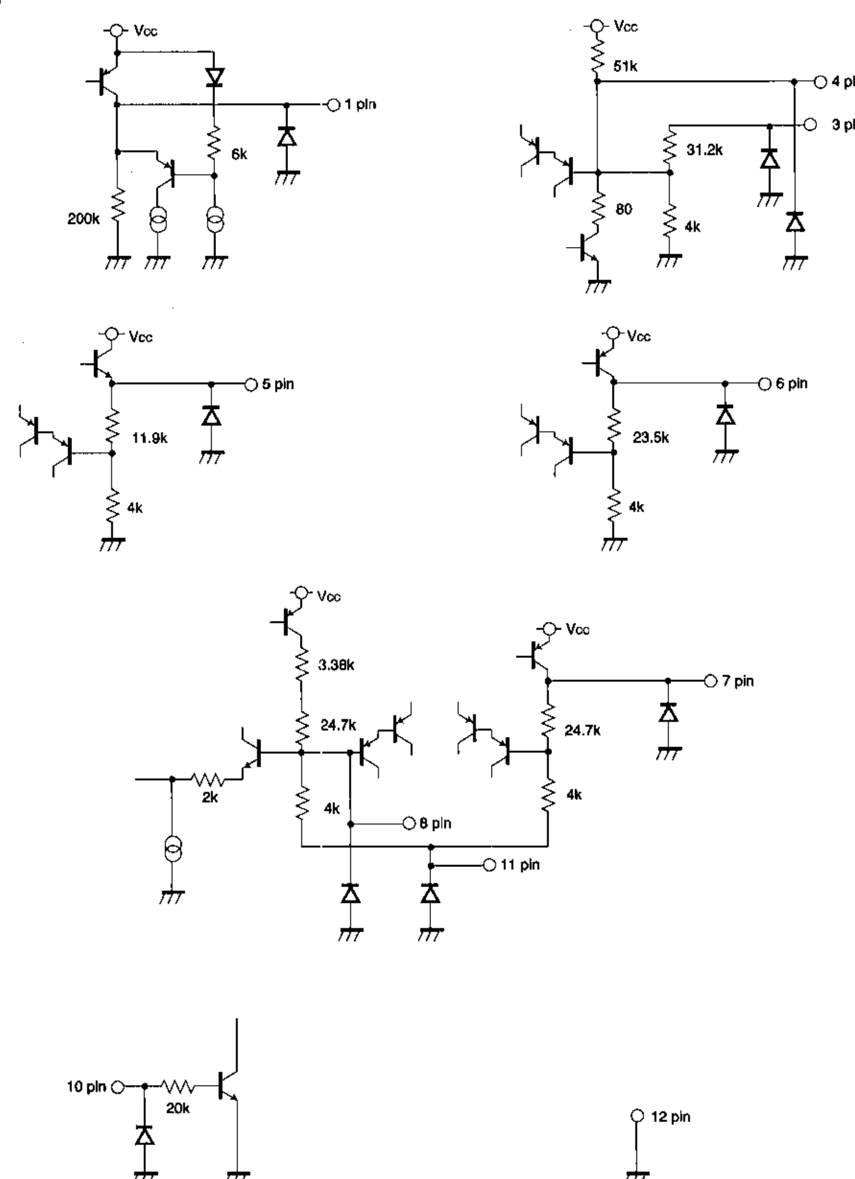
●Recommended operating conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	6.5	−	22	V

●Pin description

Pin No.	Pin name	Function
1	Vcc + B output	60 mA output current interlocked with Vcc
2	Vcc	DC supply input pin
3	External transistor collector	Output pin for external transistors
4	External transistor base	Base pin for external transistors
5	5 V output	220 mA power supply output current
6	8.5 V output	20 mA power supply output current
7	9 V output	300 mA power supply output current
8	C	Capacitor pin for improving the 9 V output ripple rejection
9	NC	
10	STAND BY	Pin for ON/OFF control of each output
11	PRE GND	Small current GND
12	GND	Large current GND

●Input / output circuits



Unit : R 〔Ω〕

●Electrical characteristics (unless otherwise noted, Ta=25℃ and V_{CC}=15.0V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
Standby circuit current	Ist	—	0	10	μA	STB pin = 0 V
Output voltage 1 (11 V)	V_{O1}	10.45	11.0	11.55	V	Load current = 550 mA, external transistor (2SB1185, F-rank)
Base current drive capacity	I_{O1}	22	32	40	mA	
Output voltage 2 (8.5 V)	V_{O2}	8.0	8.5	9.0	V	I_{O2}=10mA
Voltage variation	ΔV_{O21}	—	40	200	mV	V_{CC}=10~24V, I_{O2}=10mA
Current variation	ΔV_{O22}	—	20	200	mV	I_{O2}=0~10mA
Minimum I/O voltage differential	ΔV_{O23}	—	0.3	0.5	V	I_{O2}=10mA
Output current capacity	I_{O2}	20	—	—	mA	
Ripple rejection ratio	R.R2	50	60	—	dB	f=100Hz, VRR=−10dBV
Output voltage 3 (5 V)	V_{O3}	4.75	5.0	5.25	V	I_{O3}=200mA
Voltage variation	ΔV_{O31}	—	20	200	mV	V_{CC}=7.25~24V, I_{O3}=200mA
Current variation	ΔV_{O32}	—	100	250	mV	I_{O3}=0~200mA
Minimum I/O voltage differential	ΔV_{O33}	—	1.0	1.5	V	I_{O3}=200mA
Output current capacity	I_{O31}	220	—	—	mA	
Instantaneous output current capacity	I_{O32}	500	—	—	mA	t=10ms
Ripple rejection ratio	R.R3	50	60	—	dB	f=100Hz, VRR=−10dBV
Output voltage 4 (9 V)	V_{O4}	8.5	9.0	9.5	V	I_{O4}=240mA
Voltage variation	ΔV_{O41}	—	20	200	mV	V_{CC}=12~24V, I_{O4}=240mA
Current variation	ΔV_{O42}	—	40	200	mV	I_{O4}=0~240mA
Minimum I/O voltage differential	ΔV_{O43}	—	1.1	2.1	V	I_{O4}=240mA
Output current capacity	I_{O41}	300	—	—	mA	
Instantaneous output current capacity	I_{O42}	500	—	—	mA	t= 10ms
Ripple rejection ratio	R.R4	50	62	—	dB	f=100Hz, VRR=−10dBV
Minimum I/O voltage differential (Vcc+ B)	ΔV_{O51}	—	0.3	0.5	V	I_{O5}=35mA
Current variation	ΔV_{O52}	—	20	200	mV	I_{O5}=0~35mA
Output current capacity	I_{O5}	60	—	—	mA	
Input (STB)						
Voltage when STB is OFF	V_{stOFF}	—	—	0.9	V	STANDBY state
Voltage when STB is ON	V_{stON}	1.7	—	—	V	All output ON
Input current when HIGH *	I_{H1}	—	195	300	μA	STANDBY pin = 5 V

◎ Not designed to be radiation resistance.

* Input current (HIGH) on the STANDBY pin depends on the external resistors, whose recommended resistance is 22kΩ.

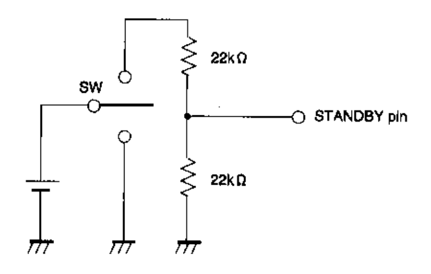


Fig.1 Standby pin external resistance

●Circuit operation

All outputs rise when voltage is applied on the STANDBY pin.

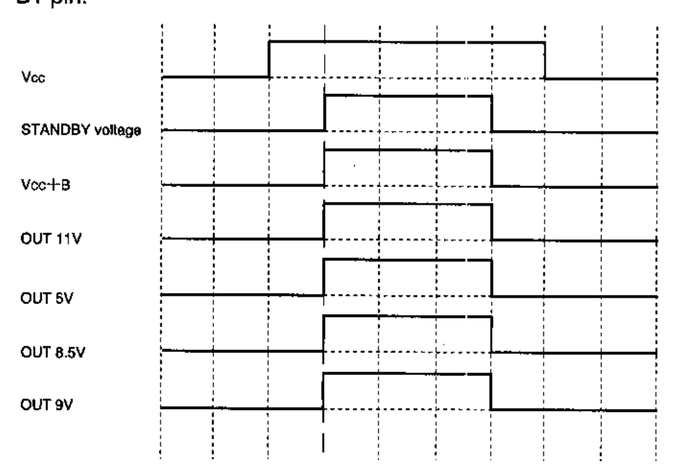


Fig.2 Timing chart

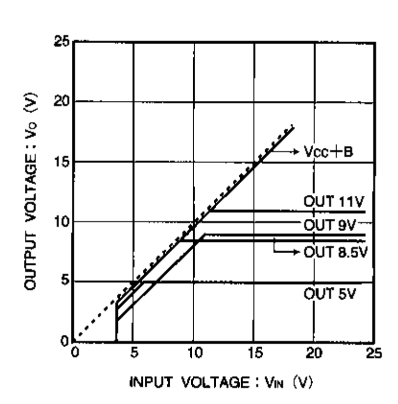


Fig.3 Input voltage vs. outpu voltage

●Application example

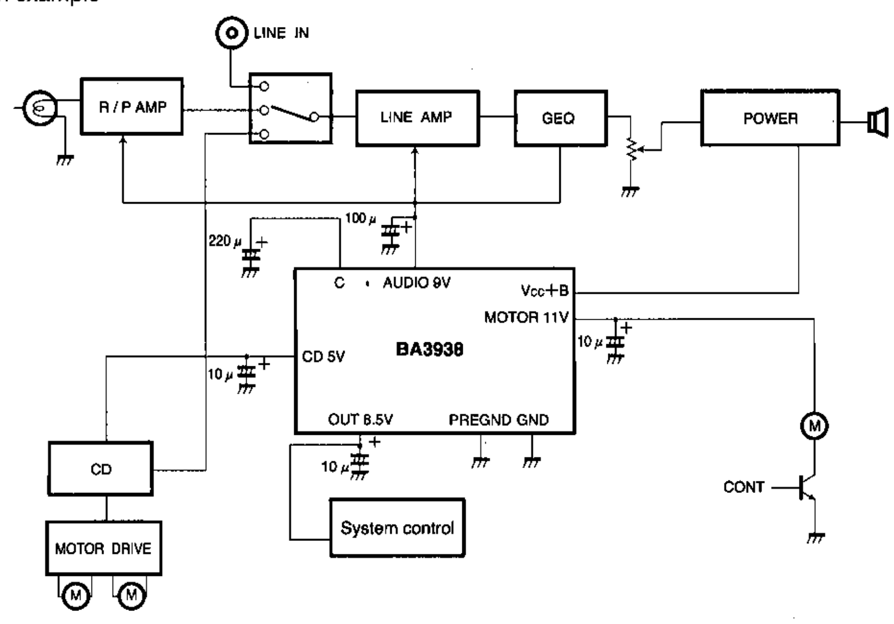


Fig.4

●Operation notes

1. Operating power supply

When operating within proper ranges of power supply voltage and ambient temperature, most circuit functions are guaranteed. Although the rated values of electrical characteristics cannot be absolutely guaranteed, characteristic values do not change drastically within the proper ranges.

2. Power dissipation (Pd)

Refer to the heat reduction characteristics (Fig. 5) and the rough estimation of IC power dissipation given on a separate page. If power dissipation exceeds the allowable limit, the functionality of IC will be degraded (such as reduction of current capacity by increased chip temperature). Make sure to use the IC within the allowable range of power dissipation with a sufficient margin.

3. Preventing oscillation at each output

To stop oscillation of output, make sure to connect a capacitor having a capacitance of 10 μF or greater between GND and each output pin. Oscillation can occur if capacitance is susceptible to temperature. We recommend using a tantalum electrolytic capacitor with minimal changes in capacitance. Also, output can be further stabilized by connecting a bypass capacitor between V_{CC} and GND.

4. Overcurrent protection circuit

An overcurrent protection circuit is installed in each output system, based on the respective output current. This prevents IC destruction by overcurrent, by limiting the current with a curve shape of "7" in the voltage-current graph (a curve shape of "inverted -L" for V_{CC} + B). The IC is designed with margins so that current flow will be restricted and latching will be prevented even if a large current suddenly flows through a large capacitor. Note that these protection circuits are only good for preventing damage from sudden accidents. Make sure your design does not cause the protection circuit to operate continuously under transitional conditions (for instance, if output is clamped at 1V_F or higher, short mode circuit operates at 1V_F or lower). Note that the circuit ability is negatively correlated with temperature.

5. Thermal protection circuit
A built-in thermal protection circuit prevents thermal damage to the IC. All outputs except Vcc + B are switched OFF when the circuit operates, and revert to the original state when temperature drops to a certain level.

6. Grounding
To minimize the variation of output voltage due to variations in load current, the GND (pin 12, for large current) and the PRE GND (pin 11, for small current) pins are separately provided. Make sure to connect circuits to correct pins.

7. STANDBY voltage
Note that ON-state voltage and HIGH-state input current of each output change when the external resistors of the STANDBY pin are changed. These values are roughly estimated as :

STB voltage when ON = 0.7 (R1 + R2) / R2
STB current when HIGH = (5 − 0.7) / R1

●Thermal derating cueves

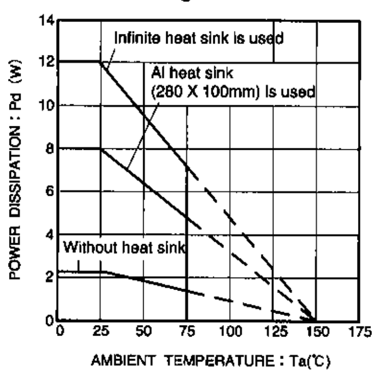


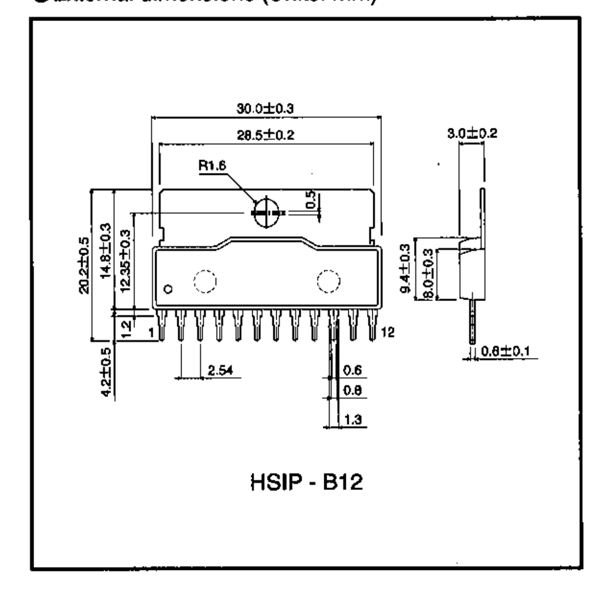
Fig.5 Thermal derating characteristics

Rough estimation of IC power dissipation ($P_{MAX.}$)

- Power consumed by Vcc + B: P_1 = (Vcc − Vcc + B) × maximum output current of Vcc + B
- Power consumed by OUT 5V: P_2 = (Vcc − 5V) × maximum output current of OUT 5V
- Power consumed by CD 8.5V: P_3 = (Vcc − 8.5V) × maximum output current of OUT 8.5V
- Power consumed by OUT 9V: P_4 = (Vcc − 9V) × maximum output current of OUT 9V
- Power consumed internally by each circuit: P_5 = Vcc × circuit current

$$P_{MAX.} = P_1 + P_2 + P_3 + P_4 + P_5$$

●External dimensions (Units: mm)



HSIP - B12